

JUL 17 2008

Application No. 10/550,564
After Final Office Action of April 17, 2008

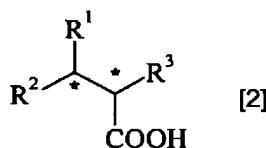
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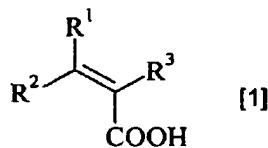
AMENDMENTS TO THE CLAIMS

This is the present listing of claims. No claim amendments are presented at this time.

1. (original): A method for producing an optically active carboxylic acid represented by the formula [2]:



wherein R¹, R² and R³ independently represent a hydrogen atom, an alkyl group, an alkenyl group or an aryl group, the groups may have a substituent, R¹, R² and R³ is not a hydrogen atom simultaneously, R³ is a group other than a hydrogen atom when one of R¹ and R² is a hydrogen atom, R³ is a group other than a hydrogen atom and a methyl group when both of R¹ and R² are hydrogen atoms, and R¹ and R² are different groups other than a hydrogen atom when R³ is a hydrogen atom, and at least one of the two carbon atoms marked with * represents an asymmetric carbon atom, comprising the step of subjecting an α, β-unsaturated carboxylic acid represented by the formula [1]:



wherein R¹ to R³ have the same meanings as those in the formula [2], in the presence of a sulfonated BINAP-Ru complex represented by the formula [3]:



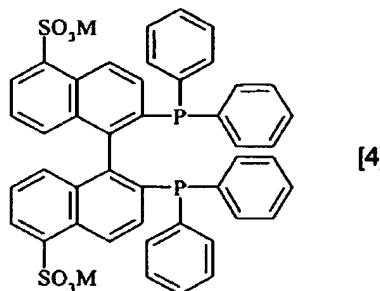
wherein (SO₃M)₂-BINAP represents a tertiary phosphine represented by the formula [4]:

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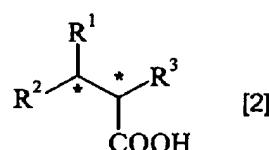
M represents an alkaline metal atom, X represents a chlorine atom, a bromine atom or an iodine atom, and arene represents a benzene or an alkyl-substituted benzene, in an aqueous solvent, to an asymmetric hydrogenation.

2. (original): The method according to claim 1, wherein the aqueous solvent is water or a mixed solvent of water and a water-insoluble organic solvent.

3. (original): The method according to claim 1, wherein the sulfonated BINAP-Ru complex is recovered.

4. (original): The method according to claim 1, wherein the sulfonated BINAP-Ru complex is recycled.

5. (original): A method for producing an optically active carboxylic acid represented by the formula [2]:



wherein R¹, R² and R³ independently represent a hydrogen atom, an alkyl group, an alkenyl group or an aryl group, the groups may have a substituent, R¹, R² and R³ is not a hydrogen atom simultaneously, R³ is a group other than a hydrogen atom when one of R¹ and R² is a hydrogen atom, R³ is a group other than a hydrogen atom and a methyl group when both of R¹ and R² are hydrogen atoms, and R¹ and R² are different groups other than a hydrogen atom when R³ is a hydrogen atom, and at least one of

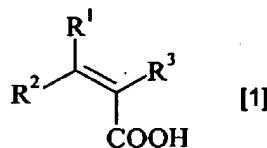
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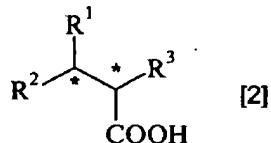
the two carbon atoms marked with * represents an asymmetric carbon atom, comprising the step of subjecting an α , β -unsaturated carboxylic acid represented by the formula [1]:



wherein R¹ to R³ have the same meanings as those described above, in the presence of a recovered sulfonated BINAP-Ru complex used in the method according to claim 1 in water or a mixed solvent of water and a water-insoluble organic solvent to an asymmetric hydrogenation.

6. (original): The method according to claim 5, wherein the α , β -unsaturated carboxylic acid is hydrogenated in the presence of an aqueous solution containing the sulfonated BINAP-Ru complex, and the aqueous solution is obtained by separating a water phase from the reaction mixture after the asymmetric hydrogenation in the method according to claim 1.

7. (new): A method for producing an optically active carboxylic acid represented by the formula [2]:



wherein R¹, R² and R³ independently represent a hydrogen atom, an alkyl group, an alkenyl group or an aryl group, the groups may have a substituent, R² and R³ is not a hydrogen atom simultaneously, R³ is a group other than a hydrogen atom when one of R¹ and R² is a hydrogen atom, R³ is a group other than a hydrogen atom and a methyl group when both of R¹ and R² are hydrogen atoms,

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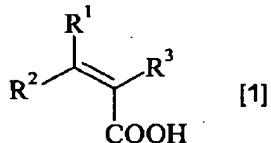
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and R¹ and R² are different groups other than a hydrogen atom when R³ is a hydrogen atom, and at least one of the two carbon atoms marked with * represents an asymmetric carbon atom,

comprising the step of:

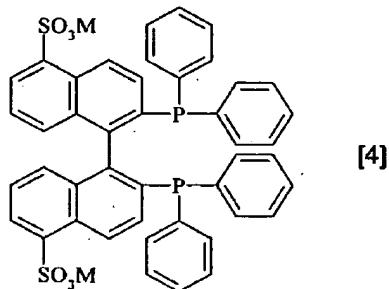
(a) subjecting an α,β-unsaturated carboxylic acid represented by the formula [1]:



wherein R¹ to R³ have the same meanings as those in the formula [2], in the presence of a sulfonated BINAP-Ru complex represented by the formula [3]:



wherein (SO₃M)₂-BINAP represents a tertiary phosphine represented by the formula [4]:



wherein M represents an alkaline metal atom, X represents a chlorine atom, a bromine atom or an iodine atom, and arene represents a benzene or an alkyl-substituted benzene, in an aqueous solvent, to an asymmetric hydrogenation;

(b) recovering an aqueous solution containing the sulfonated BINAP-Ru complex

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represented by the formula [3] by separating a water phase from the reaction mixture after the asymmetric hydrogenation;

(c)subjecting_an α , β -unsaturated carboxylic acid represented by the formula [1] in the presence of the sulfonated BINAP-Ru complex represented by the formula [3] in the aqueous solution which is recovered, in an aqueous solvent, to an asymmetric hydrogenation;

wherein the sulfonated BINAP-Ru complex is recycled by repeating the above (b) to (c).

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